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An Empirical Investigation of the Impact of GPA on Perceived Improvement of Higher-Order Cognitive Skills

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ABSTRACT

Colleges of Business have experienced high growth rates in the past decade and many colleges are imposing minimum grade point average (GPA) requirements for students entering and remaining in the College. A primary reason for this requirement, presumably, is that students with a high GPA are of a high caliber and are more inclined than those with a low GPA to demonstrate higher-order cognitive skills. However, it is not clear whether the link is valid. This study hypothesizes that, compared to students with a lower GPA, students with a high GPA, and who are taught in the same way, will have a greater tendency to perceive improved higher-order cognitive skills.

We conducted an experiment in which use of multimedia instructional materials was the common method of instruction to groups of students with high GPA and low GPA at two large universities. We obtained the students' perceptions on improved higher-order cognitive skills from their answers to questions on a survey. A regression analysis of the data revealed that the relationship between the GPA and perceived higher-order cognitive skills improvement was highly significant ($p = 0.001$). This leads to several conclusions and recommendations for the College of Business faculty members and administration.

Keywords

Multimedia, GPA, higher-order cognitive skills

INTRODUCTION

Need for Study

College of Business (COB) educators prepare students to be successful as they go on to enter the work force by providing an education that encompasses good decision-making skills (King, 2000). This entails combining appropriate technical skills with good business and communication skills (Tucker and McCarthy, 2001). The acquisition of such skills enables students to clearly communicate highly technical issues to non-technical personnel in a way they can comprehend (Lim and Benbasat, 2000; Tucker and McCarthy, 2001). Emphasizing this point, researchers (Guzdial and Soloway, 2002; King, 2000) state that to prepare students for success in the work force it is critical to provide them an education that helps to improve skills such as reasoning, problem identification, criteria specification, integrating and interrelating content, and problem solving.

Many COBs have adopted a minimum cumulative grade point average (GPA) requirement in order to attract higher caliber students to their programs. For instance, Florida State University recently raised the GPA requirement for admission to all of their undergraduate business majors from 2.60 to 2.75 (Florida State University, 2003). This was soon followed by a further increase from 2.75 to 2.90 in Fall 2004. Other universities have enforced minimum cumulative GPA requirements for admission to their COB. These include the University of Houston's C. T. Bauer College of Business and the University of Iowa's Henry B Tippie College of Business with new minimums of 2.75 (University of Houston, 2003; University of Iowa,

2003). The COBs at Auburn University and the University of Alabama have recently followed suite with the former increasing its minimum GPA requirement for all upper-level business courses from 2.0 to 2.2 and the latter requiring a minimum 2.5 GPA to remain in the college.

Sometimes the non-business Colleges within a University do not appreciate these changes because the increased GPA requirement limits the number of students in their program who eligible to take COB classes. For example, a student in hospitality management might be enrolled in the College of Arts & Sciences, but may have to take many courses in the COB. A minimum GPA requirement in the COB limits the number of students who graduate from such programs (unless the minimum GPA requirement is geared towards COB majors only). As the need for business knowledge becomes more universal among students from other disciplines, the pressure will increase on the COBs to provide business courses. At the same time, due to accreditation standards, other Colleges and Schools within the University cannot offer business courses and are dependent on the COB for their students to obtain business education. For other colleges in a University system to accept the need for COBs to impose minimum GPA standards, it is important that studies are performed to show the influence of GPA on the improvement of students' skills. Therefore, we formulated the following research question:

- What's the nature of the relationship between a student's cumulative GPA and perceived improvement of higher-order cognitive skills?

In the next section, we discuss the theoretical basis for this study and resulting hypothesis. Next, we discuss the research methodology, which is followed by the presentation of the results of the analysis. The article concludes with the discussion of the results and conclusions.

THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

In this section, we define the term higher-order cognitive skills and then develop the research hypothesis.

Higher-order Cognitive Skills

The development of students' higher-order cognitive skills, namely the abilities of critical thinking, decision-making, question asking, and problem solving, is emphasized as the superordinate goals in technical, scientific, business, and medical education (Zoller, 1994). It involves identifying options or alternatives through the synthesis of data, and then selecting an option or alternative that best meets the desired outcome. In other words, since higher-order cognitive skills is purposeful, outcome-directed thinking, the outcome directs and gives meaning to the task (Hingorani and Sankar, 1998; Notar, Wilson and Ross, 2002; Zoller, 2000, 2002).

HOCS relate to the perception that an individual has acquired an adequate portfolio of skills to make a decision within a specified period of time. It implies an improved ability to identify, integrate, evaluate, and interrelate concepts, and hence make the appropriate decision(s) in a given problem-solving situation (Hingorani and Sankar, 1998; Notar et al., 2002; Zoller, 2000, 2002).

RESEARCH HYPOTHESIS

Prior research indicates that it is commonly believed that GPA partially reflects the combination of students' intelligence and motivation and other abilities needed on the job (Brown and Campion, 1994; Ickes, Stinson, Bissonnette and Garcia, 1990). Studies on the motives and motivation for learning in education and work and the motivational effects of learning in education highlight the goals that motivate human endeavor. For instance, Vaie, et al.'s (2003) study revealed "students' predisposition to feel responsible for the results of their academic behavior (internal attribution) is related to positive self-image (academic self-concept)." But both internal attribution and academic self-concept are important conditions for development of learning-oriented motivation (learning goals) (Vaie et al., 2003). The development of learning goals involves selection and use of learning strategies, such as those aimed at fostering students' higher-order cognitive skills and developing deep learning strategies (Vaie et al., 2003). Vaie, et al. (2003) also noted that deep learning strategies lead "students to assume responsibility with high levels of persistence, perseverance, and tenacity to achieve goals defined by the motivational orientation." It is believed that this persistence and effort to achieve the proposed goals has, in turn, a positive and significant effect on academic achievement, and thus GPA.

Therefore, the research hypothesis arises:

H1: Compared to students with a low GPA, students with a higher GPA will perceive a higher improvement of their higher-order cognitive skills when exposed to the same courses and teaching methods.

In the next section, we describe the methodology used to test the hypothesis.

METHODOLOGY

Selection of Treatment

Many methods are available that help students develop, demonstrate, and improve higher-order cognitive skills. In order to conduct this study, a major requirement is to identify a method that has been validated and shown to improve the development of higher-order cognitive skills in students. For instance, online debates and peer-tutoring (Fox and MacKeogh, 2003), personalized system of instruction (PSI) (Reboy and Semb, 1991), and project-based learning (Liu, 2003) have all been shown to be effective means of helping students learn, develop and utilize higher-order cognitive skills. However, these methods have not been validated to show whether they improve higher-order cognitive skills. In contrast, the multimedia case study methodology has been validated and shown to improve higher-order cognitive skills in students (Hingorani and Sankar, 1998; Mbarika, Sankar and Raju, 2003; Mbarika, Sankar, Raju and Raymond, 2001). Therefore, we chose to use this method as the treatment in this study.

Definition of Multimedia

The term multimedia generally refers to the combination of several media of communication such as text, graphics, video, animation, music, and sound effects (Gaytan and Slate, 2002/2003). When used in conjunction with computer technology, multimedia has been referred to by some as interactive media (Fetterman, 1997; Gaytan and Slate, 2002/2003). Gaytan and Slate cite four components essential to multimedia. The components include (a) a computer to coordinate sound, video, and interactivity; (b) hyperlinks that connect the information; (c) navigational tools that browse the website or web page containing the connected information; and (d) methods to gather, process, and communicate information and ideas. They further suggest that multimedia does not exist if one of these four components is missing, and depending upon which component is missing the product might be referred to by a different name. For example, the product might be referred to as (a) "mixed media" if the component that provides interactivity is missing; (b) a "bookshelf" if it lacks links to connect the information; (c) a "movie" if it lacks navigational tools allowing the user to choose his or her course of action; and (d) "television" if it does not provide users the opportunity to create and contribute their own ideas (Gaytan and Slate, 2002/2003). Thus, multimedia, appropriately defined, is "the use of a computer to present and combine text, graphics, audio, and video with links and tools that let the user navigate, interact, create, and communicate" (Gaytan and Slate, 2002/2003).

The multimedia instructional material used in this study was the *Operating Systems Choices for Chick-fil-A's Point-of-Sales Terminals* case study (Sankar and Raju, 2000). This multimedia case study was chosen because it illustrates the management decisions faced by Chick-fil-A as the organization prepared to move from its current point-of-sales (POS) system to a choice between two operating systems. The two POS systems were based on Windows NT technology and Windows CE technology. This case study had been earlier shown to improve perceived higher-order cognitive skills in students (Mbarika, 2003).

Subjects

Junior- and senior-level undergraduate students, from two major universities in the southeastern United States, were selected as the participants in this study. Seventy-eight participants were selected from an IS undergraduate course, in which school A accounted for 28 participants and school B accounted for the remaining 50 participants.

Instrument Development

A questionnaire was designed to elicit responses related to the items that measure higher-order cognitive skills. The questions were similar to those used in earlier studies, thereby reinforcing construct validity. For instance, the instrument used by Kramer et al. (1995) served as the basis for the development of the instrument used in this study. Hingorani and Sankar (1998) expanded the instrument used by Kramer et al. in an effort to assess students' perceptions of the improvement in their higher-order cognitive skills. After this expansion of the instrument, others (Marghitu, Sankar and Raju, 2003; Mbarika, 1999; Sankar and Raju, 2002) continued to refine it. The continued refinements led to a more comprehensive instrument intended to measure students' perceptions of the value of multimedia instructional materials in improving learning. In addition to the refinements made above, studies by Mbarika (2003) and Mbarika et al. (2003; 2001) have continued to validate the instrument. This study focuses on a single construct, higher-order cognitive skills, that is geared towards measuring students' perception of their learning improvement as a result of using the multimedia case study. The items used to measure this construct based on a 5-point Likert scale ranging from 1, "strongly disagree," to 5, "strongly agree," are as follows:

- I improved my ability to **identify** operating and information system issues.
- I improved my ability to **integrate** operating and information system issues.
- I improved my ability to **evaluate critically** operating and information system issues.
- I became more **confident** in **expressing** my **ideas**.
- I learned to **interrelate** important topics and ideas.
- I learned to **solve problems** based on business theories

PROCEDURE

The students were introduced to the Chick-fil-A case study during two lecture sessions. Then the students worked in teams, randomly assigned by the instructor. Each team was required to determine which operating system would be a better choice for Chick-fil-A's POS terminals. In order to make the tasks more realistic, each team was responsible for taking and defending a different position on the issue. In making their final decision and recommendations, each team had to take the following into consideration: (a) the mission of Chick-fil-A, (b) depreciation of existing systems, (c) projected return on investment (ROI) of new systems, (d) total cost of ownership (TCO) of existing and new systems, (e) employee retention, training, and education, (f) alignment of Chick-fil-A's IT Strategy and Business Strategy, (g) competitive advantage, and (h) Chick-fil-A's critical success factors (CSF). The teams' tasks culminated with the delivery of a written report and an oral presentation of their decision and recommendations. Upon completion of the multimedia case study, the students completed a questionnaire where they were asked to indicate the extent of their agreement with six evaluatory statements that measure the higher-order cognitive skills construct (HOCS).

The construct reliability was checked by computing a Cronbach Alpha (Hair, Anderson, Tatham and Black, 1998). The Cronbach Alpha value ranges from 0 to 1 and depicts the degree to which the items coalesce together and are indicative of the construct (Hair et al., 1998). Treacy (1985) states that a value of 0.70 and higher is an acceptable level of Cronbach's Coefficient Alpha to ensure construct validity.

Multiple regression analysis was used to test the research hypothesis. Multiple regression analysis meets the research objective of providing a means of objectively assessing the degree and character of the relationship between cumulative GPA and students' perceived improvement of their higher-order cognitive skills. The model in question is a second-order polynomial regression model since it includes a squared term. The independent variables in the model consist of cumulative GPA, cumulative GPA squared, and university. University, a dichotomous variable, is included in the model to control for any school effect. A quadratic term for GPA was added to the model to for the purpose of compensating for the nonlinear relationship between GPA and HOCS. The resulting research model is

$$HOCS = \beta_0 + \beta_1 GPA + \beta_2 (GPA * GPA) + \beta_3 (University) + \epsilon_1$$

RESULTS

The Cronbach index of reliability for the construct used in this study is 0.87, a level above the acceptable level. This indicates that all the six items satisfactorily coalesce together to measure the HOCS construct. Table 1 provides the mean and standard deviation for all the items used in this study. The mean and standard deviation for the resulting HOCS construct are 3.9 and 0.77 respectively.

Table 2 reports the results of the regression of HOCS on GPA and University. The following model is yielded from the regression analysis:

$$HOCS = -8.4 + 4.26X_1 - 4.14X_2 - .18X_3.$$

The global F test was used to test the null hypothesis that there is no relationship between the response variable and the predictor variable sets. The regression model for HOCS is significant at $p < .001$ (see Table 2). The result of the multiple regression analysis indicates that the impact of GPA on students' perceptions of the improvement of their higher-order cognitive skills is significantly different from zero, thus H1 is supported. It should also be noted that University was found to be an insignificant predictor of higher-order cognitive skills. In the next section, we discuss the results of the study and their implications.

Construct (Coefficient Alpha)	Items	Mean (Std Dev.)
	I improved my ability to identify operating and information system issues.	3.97 (1.03)
	I improved my ability to integrate operating and information system issues.	3.86 (.88)
	I improved my ability to evaluate critically operating and information system issues.	3.96 (.89)
	I became more confident in expressing my ideas .	3.73 (1.00)
	I learned to interrelate important topics and ideas.	3.78 (.85)
	I learned to solve problems based on business theories	4.12 (1.28)
Higher-order Cognitive Skills ($\alpha=0.87$)		3.90 (.77)

Table 1. Construct Items and Measurement Reliability

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.461 ^a	.213	.181	.70479

a. Predictors: (Constant), University, GPA*GPA, GPA

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.944	3	3.315	6.673	.000 ^a
	Residual	36.758	74	.497		
	Total	46.702	77			

a. Predictors: (Constant), University, GPA*GPA, GPA

b. Dependent Variable: HOCS

Coefficients^a

Model		Coefficients	Std. Error	t	Significance
1	(Constant)	-8.395	3.582	-2.344	.022
	GPA	.7991	.2326	3.436	.001
	University	-.297	.181	-1.640	.105

a. Dependent Variable: HOCS

Table 2. Results of Regression Analysis

DISCUSSION AND IMPLICATIONS

In this study, we examined the impact of GPA on students' perceived improvement in higher-order cognitive skills. The results indicate that, for a given learning environment favorable to attainment of higher-order cognitive skills, the students' level of cumulative GPA influences their perception of higher-order cognitive skills improvement. Consequently, it is

expected that students with a low GPA will perceive a lower level of improvement in higher-order cognitive skills than students with a high GPA. Although the results of this study indicates that the relation between GPA and HOCS follows the shape of inverted “U”, it is important to note that students with an extremely high GPA still perceive more improvement in their higher-order cognitive skills than students with an extremely low GPA. In other words, after the GPA reaches a certain threshold, the perceived improvement in higher-order cognitive skills starts to diminish. However, the perceived improvement of higher-order cognitive skills levels off and doesn’t return to the point of being equivalent to the perceptions of students with a low GPA.

Liberal admission policies, with regards to GPA, may prohibit or dampen the development, utilization and improvement of higher-order cognitive skills in COB students. This is to say that liberal admission policies will allow students with a low GPA to pursue a degree within the College of Business. Given that one of the primary objectives of educators is to prepare students to be successful as they go on to enter the work force by providing an education that encompasses good decision-making and problem-solving skills. Admitting students with a low GPA could possibly undermine the objectives of the educator. Our position is based on the premise that a low GPA usually translates into feelings of inferiority, which impacts students’ perception of their skill development. It is plausible for these students to feel as if they’re incapable of garnering the skills needed to be successful, and they, therefore, do not perceive improvement of existing skills or the development of new skills.

The results of this study have significant implications for COB administrators and researchers. For researchers, the methodology of using Multimedia Instructional Materials to improve higher-order cognitive skills in students is well cited in the literature (Mbarika, 2003; Mbarika et al., 2003; Raju and Sankar, 1999; Sankar and Raju, 2002). This study contributes by considering GPA as a predictor of students’ perceptions of the improvement of their higher-order cognitive skills when using Multimedia Instructional Materials.

The instrument used in this study has been validated by the previously mentioned studies, and lends itself for use in other curriculums to measure these and other aspects of higher-order cognitive skills. Likewise, the method of using Multimedia Instructional Materials as a catalyst to improve such skills in students of other disciplines provides a great opportunity for future research. Bearing in mind that other factors need to be considered when using these instructional materials to teach business courses, the materials may need to be adapted and modified to suit a particular audience. This will require more work on the part of the instructor, but can prove to be very rewarding for both the student and the instructor in the end. This is further illustrated by the National Science Foundation’s willingness to provide an Adaptation and Implementation grant in addition to an Instructional Material Development grant. Furthermore, the NSF’s policy of encouraging educators to adapt and implement exemplary materials such as the multimedia case studies is a worthwhile effort and needs to be continued.

LIMITATIONS

The results of this study have some limitations that need to be recognized. Since the majority of the students participating in this study were from the College of Business, one should be careful when attempting to generalize the results of this study to populations in other disciplines. Care must also be taken when attempting to generalize the results of this study to students with a cumulative GPA less than 2.0. Such generalizations would lead to extrapolation beyond the data observed in the sample for this study. Further research needs to be conducted in this area before these results can be generalized to other populations.

Replication of this study with an even larger sample size would improve the validity of this study. Others who attempt to replicate this study may find it useful to include other potential predictors of the response variables, such as age, gender, ethnicity, previous years of work experience, major GPA, and year in program of study (i.e. Freshman, Sophomore, Junior, Senior). Another extension to this study that would add value to the literature and provide even more insight would be to include academic performance measures that capture students’ actual learning.

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